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STATE OF MISSOURI

TITLE OF JOB: A Study of Pond Fish Stocking Combinations

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Study I-0. A Study of Pond Fish Stocking Combinations

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Abstract

Three species combinations, largemouth bass - redear sunfish - red shiner, largemouth bass - golden shiner, and largemouth bass - bluegill, were studied during 1968 - 1970 to determine their relative merits for stocking ponds.

During 1968, bass in the largemouth bass - redear sunfish - red shiner combination exhibited the best overall growth, however, the largest individual bass was found in the largemouth bass - golden shiner combination. Growth of original stock bass in the largemouth bass - bluegill combination was less than in the other combinations tested.

Fish growth for 1969 was quite different. Bass grew best in the largemouth bass - bluegill combination and poorest in the largemouth bass - redear sunfish - red shiner combination. Although two of the three largemouth bass - redear sunfish - red shiner ponds became contaminated with bluegill and were terminated in the fall of 1969, a noticeable shortage of young-of-the-year redear sunfish was apparent.

The best overall bass growth in 1970 was found in the largemouth bass - bluegill combination. Bluegills grew well until they reached about 6 inches in total length, then their growth was slower. In most situations, bluegills over 6 inches in total length appeared emaciated and in poor physical condition. The poorest overall bass growth occurred in the largemouth bass - golden shiner combination. Two of the three ponds lacked golden shiners when drained in the fall of 1970.

Golden shiners provide excellent bass forage for two or three years, then disappear from the pond fish population because of heavy bass predation

on young-of-the-year shiners. Few individuals reach sexual maturity. Original stock golden shiners succumb to natural mortality after the second or third year and the forage base is lost. The largemouth bass - redear sunfish - red shiner ponds looked promising until they became contaminated with bluegills and were terminated from the study. The concept of a multiple forage base in ponds is relatively new in Missouri and merits further investigation. Until a multiple forage system can be tested, largemouth bass - bluegill remains the most desirable pond fish combination. Bluegills are extremely susceptible to overpopulation if the pond is not properly managed.

Study I-9. A Study of Pond Fish Stocking Combinations

Larry K. Graham, Project Leader

Introduction

The objective of this study was to determine the merits of several combinations of fish species for stocking farm ponds. Criteria for evaluation included selecting a forage species that would reproduce in sufficient numbers to provide adequate bass forage, and be able to sustain itself as a forage species. Three combinations were tested in nine half-acre ponds at the Little Dixie Wildlife Area. Largemouth bass (100 per acre) were stocked in combination with each of the following forage species: (1) bluegills (500 per acre), (2) golden shiners (1,000 per acre), and (3) redear sunfish (300 per acre) and red shiners (1,000 per acre). Three replications of each combination were stocked in the fall of 1967, with the exception of the largemouth bass - bluegill combination, which was added to the study in early spring, 1968. All fish stocked were less than 3 inches in total length. These populations were allowed to develop under as near natural conditions as possible for three years and were sampled each succeeding fall by either seining or pond draining. During the summer of 1970, 20 per cent of the original stock largemouth bass were harvested to better represent a typical farm pond that had developed its fish population for two growing seasons and had been fished the third summer. Limnological data (temperature, conductivity, and turbidity) were obtained weekly during the fish growing season.

Fish Populations

Fish populations were sampled in the fall of 1968 and 1969, after a partial drawdown, by seining with a 150 foot, half-inch mesh seine. A

25-foot, one-quarter-inch mesh bag seine was also used during 1969. In the fall of 1970, all ponds were drained and their entire fish populations captured. The best overall bass growth for 1968 occurred in the largemouth bass - redear sunfish - red shiner combinations (Table 1), however, in 1969 and 1970, the best overall bass growth occurred in the largemouth bass - bluegill ponds (Tables 2 and 3, respectively). During 1968 and 1969, fall seining indicated a shortage of catchable-size bass in the largemouth bass - bluegill ponds, however, when these ponds were drained in the fall of 1970, it was found that an average of 65 per cent of the original stock bass were present. In the largemouth bass - golden shiner ponds, an average of 74 per cent of the original stock bass was present after three growing seasons. The difference in bass survival cannot be fully explained. During 1968, average lengths and weights of bass in the largemouth bass - redear sunfish - red shiner combination were 0.9 inches and 2.9 ounces greater than in the other combinations. However, the fastest growth of an individual bass was in the largemouth bass - golden shiner ponds where one fish attained a length of 12.0 inches and a weight of 18.5 ounces. During this same year, the poorest bass growth among the three combinations tested was in the largemouth bass - bluegill ponds.

In 1969, the largemouth bass - bluegill combination had the best overall growth of bass. Average lengths and weights of bass in this combination were 0.9 inches and 5.0 ounces greater than in the other combinations. The largest individual bass was found in the largemouth bass - bluegill combination and attained a length of 15.0 inches and a weight of 34.0 ounces. The poorest bass growth among the three combinations tested was in the largemouth bass - redear sunfish - red shiner ponds. This combination became heavily contaminated with bluegill and was terminated from the study in the fall of 1969.

Table 1. Length and weight, in inches and ounces, of original stock largemouth bass (predator species) and various forage species, from a fall seining sample in the Little Dixie research ponds, 1968.

Combination	Total number of fish	<u>Predator Species</u>			<u>Forage Species</u>		
		Average length	Length range	Average weight	number of fish	Average length	Length range Average weight
Bass - golden shiner	77	9.2	7.4 - 12.0	7.1	151	5.6	4.6 - 6.5 1.3
Bass - bluegill	49	9.0	7.6 - 10.9	6.4	277	4.8	3.4 - 5.6 1.2
Bass - redear sunfish	75	10.0	6.5 - 11.9	9.6	157	5.7	5.3 - 6.6 2.1
- red shiner					1	3.5	

Table 2. Length and weight, in inches and ounces, of largemouth bass (predator species) and various forage species from a fall seining sample, in the Little Dixie research ponds, 1969.

Combination	Predator Species			Forage Species		
	Total number of fish	Average length	Length range	Average weight	Total number of fish	Average length
Bass - golden shiner						
Adult	59	12.3	10.9 - 14.1	16.7	366	7.2
Intermediate	23	7.4	4.8 - 8.3	3.1	430	4.9
Y-O-Y	46	2.4	1.6 - 3.5	0.5	8	2.8
Bass - bluegill						
Adult	26	12.8	11.0 - 15.0	19.7	77	5.7
Intermediate	14	6.8	4.6 - 8.2	2.5	106	3.9
Y-O-Y	25	2.5	2.5 - 2.8	0.5	30	2.1
Bass - redear						
Adult	60	11.6	10.6 - 13.1	13.4	271	7.5
Intermediate	23	7.3	4.7 - 10.4	3.5	86	4.8
Y-O-Y	15	2.9	1.9 - 4.5	0.5	13	2.3
- red shiner						
Adult	3					
Intermediate	38					
Y-O-Y	0					

Table 3. Length and weight, in inches and ounces, of largemouth bass (predator species) and various forage species, after fall draining, in the Little Dixie research ponds, 1970.

Combination	Predator Species			Forage Species		
	Total number of fish	Average length	Length range	Average weight	Total number of fish	Average length range Average weight
Bass - golden shiner						
Lg. Adult	94	13.0	10.9 - 15.7	19.1	51	7.8 7.1 - 8.5 3.1
Sub. Adult	82	9.5	7.0 - 11.6	6.7	0	
Intermediate	48	6.3	4.4 - 6.9	2.0	0	
Y-O-Y	5,661	2.4	1.6 - 3.6	0.5	0	
- green sunfish (contamination)						
					1	7.1 4.0
Bass - bluegill						
Lg. Adult	76	13.5	11.1 - 16.6	21.8	292	6.2 5.2 - 7.5 2.7
Sub. Adult	61	8.1	5.3 - 10.1	6.2		
Intermediate	21	5.0	3.5 - 5.1	2.5	1,933	4.3 3.0 - 5.0 1.0
Y-O-Y	4,093	1.8	1.4 - 2.3	0.5	19,910	1.8 1.4 - 2.8 0.5
- green sunfish (contamination)						
Adult					28	6.8 4.7 - 7.7 3.6
Intermediate					20	4.5 3.5 - 4.5 0.9
Y-O-Y					676	2.1 1.9 - 2.5 0.5

As in the previous year, the best overall bass growth for 1970 was in the largemouth bass - bluegill combination. The bass were 0.5 inches longer and 2.7 ounces heavier on the average than bass from the largemouth bass - golden shiner ponds. The largest individual bass was found in the largemouth bass - bluegill combination and attained a total length of 16.6 inches and a weight of 41.0 ounces. In 1970, the average standing crop of bass in the largemouth bass - golden shiner ponds was 64 pounds and the average standing crop of bass in the largemouth bass - golden shiner ponds was 43 pounds. The standing crop of bass in the ponds seem to be a direct reflection of the survival of original stock bass in the two fish combinations.

Bass growth in 1968 and 1970 was not effected by turbidities. Ponds were generally not turbid except after periods of strong wind or rain and usually cleared within a few days. The poor growth rate of bass in the largemouth bass - redear sunfish - red shiner combination during 1969 may be attributed to turbid water which interfered with their feeding, and to an apparent absence of young-of-the-year forage fish. Turbidities (Table 4) show that in 1969, two of the three largemouth bass - redear sunfish - red shiner ponds were extremely turbid during early summer. On May 16, 1969, Ponds 13 and 17 were treated with gypsum at the rate of 12 pounds per 1,000 cubic feet of water. Within two days, colloidal clays began to precipitate and turbidities decreased. Turbid water prior to the gypsum application may have impeded fish reproduction and growth.

Forage fish fry during 1968, 1969, and 1970, were observed throughout the summer in all ponds except the largemouth bass - redear sunfish - red shiner ponds in 1969. It is possible that during 1969, the influence of turbid waters in two of the three ponds explains why no redear or red shiner fry were observed.

Table 4. Average monthly secchi disk readings, May through September, 1968, 1969, and 1970, in the Little Dixie research ponds. The largemouth bass - redear sunfish - red shiner combination was terminated in 1969 because of bluegill contamination.

Pond	1968	May 1969	1970	1968	June 1969	1970	1968	July 1969	1970	1968	August 1969	1970	1968	September 1969	1970
Largemouth bass - bluegill															
8	77	72	52	87	43	58	78	49	68	38	52	54	32	71	57
9	70	55	39	70	29	56	54	33	57	31	43	35	37	57	38
16	54	44	13	69	24	15	78	24	17	56	28	21	39	21	22
Largemouth bass - golden shiner															
2	20	68	47	20	32	32	28	30	38	31	52	63	47	63	72
4	57	72+	63	35	46	58	37	52	68	70	65	72+	84	58	72+
6	78	51	20	59	26	29	69	19	30	52	30	32	42	27	38
Largemouth bass - redear sunfish - red shiner															
13	36	9	--	29	19	--	32	21	--	32	39	--	20	40	--
17	44	13	--	41	32	--	30	25	--	25	34	--	12	28	--
20	50	44	--	31	24	--	51	19	--	35	40	--	29	29	--

During the fall population analysis in 1968, young-of-the-year redear sunfish (average total length 2.7 inches) were taken from only two ponds, and only one red shiner (average total length 3.5 inches) was collected. In 1969, 41 young-of-the-year redear sunfish were collected but 37 of them came from Pond 13. This pond also produced the only three adult red shiners collected during fall sampling. Intermediate-size redear sunfish (average total length 4.8 inches) were found in only two of the three ponds. Two of the three ponds were heavily contaminated with bluegills. The ratio of the young-of-the-year redear sunfish to bluegills in Ponds 13 and 17 approached 1:100. There was an apparent shortage of young-of-the-year redear sunfish in all three ponds. Regardless of the fact that two of the three ponds were contaminated, a noticeable shortage of forage was apparent and may account for the poor bass growth. In the largemouth bass - bluegill combination, young-of-the-year bluegills were always present in substantial numbers during all three years' fall population analysis. Golden shiner fry were observed in the largemouth bass - golden shiner combination for all three summers, however, only during 1969 were young-of-the-year golden shiners taken in the fall seining sample. In 1969, eight young-of-the-year golden shiners were collected. In these same ponds, adult and intermediate-size golden shiners (average total length 7.2 and 4.9 inches, respectively) were collected. During 1970, when the ponds were drained, 51 adult golden shiners (average total length 7.8 inches) were collected; however, all came from one pond. No intermediate-size or young-of-the-year golden shiners were taken. Green sunfish were not captured by seining during 1968 and 1969, however, they were found when ponds were drained in 1970. The largemouth bass - golden shiner combination had one green sunfish (average total length 7.1 inches), and the largemouth bass - bluegill combination had 28 adult green sunfish (average total

length 6.8 inches) and about 700 intermediate-size and young-of-the-year green sunfish.

Harvest

During the summer of 1970, 20 per cent of the original stock largemouth bass were harvested from the largemouth bass - bluegill and largemouth bass - golden shiner combination ponds. This was done to better typify a pond that had been allowed to develop its fish population for two complete growing seasons, then received fishing pressure during the third summer. Seven bass were harvested from each of the three ponds of the two combinations. Seven fish were considered to be close to a 20 per cent harvest assuming a 70 per cent survival of original stock bass. Actual average survival was 65 per cent in the largemouth bass - bluegill ponds and 74 per cent in the largemouth bass - golden shiner ponds. In the largemouth bass - bluegill combination, it required an average of 170 minutes per acre (range 80 to 240 minutes per acre) to harvest the seven bass. In the largemouth bass - golden shiner combination, it required an average of 58 minutes per acre (range 42 to 80 minutes per acre) to harvest the seven bass. This represents a catch rate of 2.5 bass per hour per acre in the largemouth bass - bluegill ponds and 7.2 bass per hour per acre in the largemouth bass - golden shiner ponds. The average total length and weight of bass harvested in the largemouth bass - bluegill combination was 12.9 inches and 19.8 ounces, while similar data for bass from largemouth bass - golden shiner ponds was 12.6 inches and 17.9 ounces. This represented an average catch of 8.1 pounds of bass from the largemouth bass - bluegill ponds and an average of 7.8 pounds of bass from the largemouth bass - golden shiner ponds. The more rapid catch rate of bass in the golden shiner forage ponds may be attributed to the fact that almost all

forage-size shiners were gone and large bass were actively swimming the banks in search of food. Similar data collected by Farabee (1970) indicates that largemouth bass catch rates were higher in ponds with relatively little forage than in ponds with high forage levels.

Results and Discussion

Redear sunfish have been tested as a forage fish in past years with varying success. Dillard (1967) found that redear sunfish stocked with only channel catfish produced a strong year-class of young-of-the-year redear and survival was good. However, in ponds containing largemouth bass and redear sunfish, survival of young-of-the-year redear was poor. Fry (1964) stated that the addition of redear sunfish would not contribute greatly to the creel after the first few years of fishing since they failed to reproduce in numbers great enough to add to subsequent year-classes. Everss (1962) noticed that adult redear sunfish were of larger size than adult bluegills, but almost no smaller-size redear could be found, whereas, small bluegills were numerous.

The largemouth bass - redear sunfish - red shiner combination was set up with the expectation that the red shiner could provide additional forage for the bass and alleviate predation on young redear. Until the combination had to be terminated due to bluegill contamination, fish populations in this combination looked very good and young-of-the-year and intermediate-size redear sunfish were present. It is recommended that further studies involving redear sunfish and at least one additional forage species be made as soon as a reliable source of redear sunfish can be obtained.

Bass growth in the largemouth bass - golden shiner combination was good throughout the study even though the ponds contained few forage-size

golden shiners after mid-summer. Strong year-classes of golden shiners were evident each spring; however, by mid-summer, their numbers were drastically reduced in face of bass predation. At time of fall fish population analysis in 1970, after three years growth, two of the three ponds lacked adult golden shiners. It seems evident that golden shiners provide excellent bass forage the first two or three years, then are lost from the pond population because of bass predation. Golden shiners might be extremely good forage if stocked in combination with largemouth bass - redear sunfish.

In the largemouth bass - bluegill combination, bluegills reproduced in good numbers and bass growth was good, however, in 1968 after one year's growth, both golden shiner and redear sunfish - red shiner combinations provided bigger bass. The bluegills grew well until they reached approximately 6 inches in total length, then growth was extremely slow. In almost all situations, bluegills over 6 inches in total length appeared emaciated and in poor physical condition. This observation cannot be fully explained at this time.

Final analysis of the three tested species combinations show that in the largemouth bass - golden shiner combination, the golden shiner provides excellent forage the first summer. Survival of young golden shiners was poor and few individuals reached sexual maturity. After three summers growth, the majority of the golden shiner population consisted of original stock fish. Regardless of the fact that golden shiners failed to maintain themselves in adequate numbers in clear ponds stocked with largemouth bass, they would be an excellent forage species to stock where multiple forage species are desired.

Even though the largemouth bass - redear sunfish - red shiner combination was terminated, the merits of the redear as a forage species have

not been fully explored. We know that when stocked with bass, redear sunfish often fail to provide adequate forage, however, the addition of another forage species looks promising. We have little information on the performance of redear in situations where the fish populations have been subjected to angling, thus, reducing the numbers of large predators (bass).

In the largemouth bass - bluegill combination, original stock bass were larger than similar bass stocked with golden shiners, but, bass numbers were reduced by mortality. The cause and exact time of this mortality is unknown. Regardless of the fact that in the largemouth bass - bluegill combination, mortality reduced the density of original stock bass and thus may have influenced their growth rates, bluegills did reproduce in sufficient numbers to sustain themselves and provide forage, whereas, golden shiners did not. Bluegills are extremely susceptible to over-population if not properly managed and growth after 6 inches is often slow, resulting in a less than desirable fish for the angler. Regardless of these traits, bluegills will remain the recommended bass forage since no other forage species tested achieved more desired results in a pond fish combination.

Recommendations

The largemouth bass - bluegill combination remains the recommended pond fish stocking combination. Bluegills provide adequate forage and can provide angling recreation if properly managed.

The concept of a multiple forage base in ponds is relatively new. Even though the largemouth bass - redear sunfish - red shiner combination was not fully evaluated, further pond combinations involving redear sunfish and at least one other forage species should be investigated.

Another aspect of the multiple forage system that warrents more study is stocking golden shiners in the spring, then adding largemouth

bass - bluegill or largemouth bass - redear sunfish in the fall. Even though golden shiners are lost from the forage base after two or three years, they will provide additional forage to insure the bass of reaching spawning size in two growing seasons.

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